APPENDIX H:

INSTRUMENT CALIBRATION AND MEASUREMENTS

This Appendix represents current equipment used by the District which may change as programmatic updates are implemented.

WATER POLLUTION PREVENTION
FUNDED BY THE CITIES AND COUNTY OF RIVERSIDE
ONLY RAIN DOWN THE STORM DRAIN
rcflood.org/NPDES
Report illegal dumping (800) 506-2555

Omega HHWT-11 Handheld Chlorine Photometer

For operational instructions with graphics, along with important notes, please refer to the **Operation Manual which can be found online at the following website**
http://www.omega.com/manuals/manualpdf/M5098.pdf

ISCO 3700 Portable Sampler

For operational instructions with graphics, along with important notes, please refer to the **Operation Manual which can be found online at the following website**
http://www.isco.com/pcfiles/PartPDF/SL000004/UP0019H4.pdf .

Hydrolab Quanta Multi-Parameter Water Quality Monitor

For detailed instructions with graphics, along with important notes, please refer to the **Operation Manual**.

A. Calibration
   1. Ensure that the sensor probe is connected.

   2. Wash the sensor in distilled water a few times and put some of the pH 4 standard solution into the calibration beaker to the marked line.

   3. Immerse the sensor in the calibration beaker.

   4. Press the **POWER** key.
      a. Use arrow keys to select 'CALIB' and press Enter
      b. Select parameter you wish to calibrate and press Enter
      c. Use arrow keys to adjust reading to standard solution press Enter

5. Fully rinse probe and calibration cup with DI water then dry before filling with next standard solution.
      a. When calibrating pH calibrate 7.0 first then 10.0 or 4.0. (NOTE Quanta only does 2 point pH calibration)
      b. When calibrating DO sensor fill cup with DI water to O-ring of membrane on DO probe. Use accurate mmHg to calibrate %DO this will calibrate mg/L DO at the same time.

B. Measurement
   1. Always attach the Guard to protect to the sensors before taking measurements.

   2. Slowly immerse the sensor in the sample.

   3. Turn the power on and allow measurements to stabilize.

   4. Record the measurements on the *Field Data Sheet* while out in the field. Select the SCREEN icon and use the **ENTER** key to switch measurement items.

   5. After taking the measurement:

      5.1 Turn the power off.

      5.2 Use DI water to completely wash off the sample on the sensor and then wipe water drops.

      5.3 Pour about 20 mL (about 2 cm from the bottom) of distilled water in the storage cup and install it on the sensor probe and store the instrument in the carrying case.

C. Specifications

Performance Specifications

	Range	Accuracy	Resolution
Temperature	-5°C to 50°C	±0.2°C	0.01°C
Dissolved Oxygen	0 to 50 mg/L	±0.2 mg/L ≤ 20 mg/L ±0.6 mg/L > 20 mg/L	0.01 mg/L
Specific Conductance	0 to 100 mS/cm	±1% of reading ±1 count	4 digits
pH	2 to 12 units	±0.2 units	0.01 units
ORP	-999 to 999 mV	±25 mV	1 mV
Vented Depth (10m)	0 to 10 m	±0.003 m (±0.01 ft)	0.001 m
Depth (25m)	0 to 25 m	±0.1 m	0.1 m
Depth (100m)	0 to 100 m	±0.3 m	0.1 m
Turbidity	0 to 1000 NTU	±5% of reading ±1 NTU	0.1 NTU < 100 NTU 1 NTU ≥ 100 NTU
Salinity	0 to 70 PSS	±1% of reading ±1 count	0.01 PSS

YSI 6920 V2 Multi-Parameter Water Quality Sonde

For detailed instructions with graphics, along with important notes, please refer to the **User Manual**.

A. Calibration

1. Ensure that the sensor probe is connected and sensor probe is fully immersed in standard solution.

2. Press the **POWER** key.
   d. Select Sonde Menu and press Enter
   e. Select Calibrate and press Enter
   f. Select parameter you wish to calibrate and press Enter
   g. Select 1-3 point calibration dependent on parameter and press Enter
   h. Type in standard solution value and press Enter
   i. Wait for readings to stabilize then press Enter to calibrate sensor

3. Fully rinse probe and calibration cup with DI water then dry before filling with next standard solution.
   a. When calibrating pH calibrate 7.0 first then 10.0 or 4.0.
   b. When calibrating optical sensors (DO or Turbidity clean optics before calibrating)
   c. When calibrating DO sensor allow atmosphere in calibration cup to stabilize for 15 mins with DI water before calibration.

B. Measurement

1. Always attach the flow-thru Guard to protect to the sensors before taking measurements.

2. Slowly immerse the sensor in the sample.

3. Turn the power on and allow measurements to stabilize.

4. Record the measurements on the *Field Data Sheet* while out in the field.

5. After taking the measurement:

   5.1 Turn the power off.

   5.2 Use DI water to completely wash off the sample on the sensor and then wipe water drops.

   5.3 Pour about 20 mL (about 2 cm from the bottom) of distilled water in the storage cup and install it on the sensor probe and store the instrument in the carrying case.

C. Specifications

6920V2-2 SONDE

Available Sensors	Temperature, Conductivity, pH, ORP, one ion selective electrode (ammonium, nitrate, or chloride), and Depth (shallow, medium, shallow vented). Two total optical sensors (ROX Optical DO, Turbidity, Chlorophyll, Rhodamine WT, BGA-PC, or BGA-PE).
Operating Environment	Medium: fresh, sea, or polluted water Temperature: -5 to +50 °C for most sensors Depth: 0 to 200 feet (61 meters)
Storage Temperature:	-40 to +60 °C for sonde and all sensors except pH , pH/ORP, ISE and optical sensors -10 to +60 °C for pH, pH/ORP, ISE, and optical sensors
Material:	Polyurethane, PVC, Stainless Steel
Diameter:	2.9 inches (7.4 cm)
Length:	Approximately 18.25 inches (46.4 cm) with no depth, 19.63 inches (49.9 cm) with depth
Weight:	Approximately 3.74 pounds (1.7 kg)
Computer Interface:	RS-232C, SDI-12
Internal logging memory size:	384 kilobytes (150,000 individual parameter readings)
Power:	8 AA-size Alkaline Batteries or External 12 VDC
Battery Life:	Approximately 32 days at 20 C at a 15 minute logging interval with ROX Optical DO, another optical sensor (turbidity, chlorophyll, Rhodamine WT, BGA-BC, or BGA-PE), temperature, conductivity, and pH active. Battery life is heavily dependent on sensor configuration and is given above for a typical sensor ensemble. If you have a different sensor configuration, set up your sonde for a deployment in the Run|Unattended menu and check the projected approximate battery life.

Temperature

Sensor Type.....Thermistor
Range.....-5 to 50 °C
Accuracy.....+/- 0.15 °C
Resolution.....0.01 °C
Depth.....200 meters

ROX Optical Dissolved Oxygen, mg/L (Calculated from % air saturation, temperature and salinity)
Sensor Type..... Optical, Luminescence Lifetime
Range.....0 to 50 mg/L
Accuracy.....0 to 20 mg/L, +/- 1 % of the reading or 0.1 mg/L, whichever is greater
20 to 50 mg/L, +/- 15 % of the reading; Relative to Calibration Gases.
Resolution.....0.01 mg/L
Temperature Range -5 to 50 C

pH
Sensor Type.....Glass combination electrode
Range.....0 to 14 units
Accuracy.....+/- 0.2 units
Resolution.....0.01 units
Temperature Range -5 to 50 C
Depth.....200 meters

Turbidity
Sensor type..... Optical, 90 ° scatter, with mechanical cleaning
Range..... 0 to 1000 NTU
Accuracy.....+/- 2% of the reading or 0.3 NTU (whichever is greater), in YSI AMCO-AEPA standards
Resolution.....0.1 NTU
Temperature Range -5 to 50 C
Depth..... 61 meters

Conductivity*
Sensor Type.....4 electrode cell with autoranging
Range.....0 to 100 mS/cm
Accuracy.....+/- 0.5% of reading + 0.001 mS/cm
Resolution.....0.001 mS/cm to 0.1 mS/cm (range dependent)
Temperature Range -5 to 60 C
Depth.....200 meters

Horiba U-22XD Multi-Parameter Water Quality Monitoring System

For detailed instructions with graphics, along with important notes, please refer to the **Operation Manual**.

A. Calibration
   1. Ensure that the sensor probe is connected.

   2. Press the **POWER** key.

   3. Wash the sensor in distilled water a few times and put some of the pH 4 standard solution into the calibration beaker to the marked line.

   4. Immerse the sensor in the calibration beaker.

   5. Press the CAL auto calibration mode key in one of the Measurement modes **pH**, **COND**, **TURB**, **DO**. **AUTO** and **CAL** appear and the instrument enters the **AUTO** calibration mode.

   6. Press the **ENT** key to start **AUTO** calibration. Upon completion of the **pH**, **COND**, **TURB**, **DO**, and **DEP** modes, "End" will be displayed on the screen.

   7. Press the **MEAS** key to return to the Measurement mode.

B. Measurement
   1. Slowly immerse the sensor in the sample.

   2. Select the measurement item. Use the **MEAS** key to switch measurement items in the following order: **pH**, **COND**, **TURB**, **DO**, **TEMP**, **DEP**, **SAL**, **TDS**, **σ**, **ORP**, **TIME**, then back to **pH**.

   3. After taking the measurement:

      3.1 Turn the power off.

      3.2 Use tap water to completely wash off the sample on the sensor and then wipe water drops.

      3.3 Pour about 20 mL (about 2 cm from the bottom) of distilled water in the probe cap and install it on the sensor probe. Place the rubber cap on the connector and store the instrument in the carrying case.

   4. Water quality data should always be recorded to the *Field Data Sheet* while out in the field. To additionally manually store the measurement data (up to 2880 sets) in the instrument for later download:
      4.1 Make sure that **MAN** is displayed as the Measurement mode.

      4.2 Press the **ENT** key. Data storage starts, **DATA IN** and the data set number is displayed on the screen, and the measured value to be stored and the measurement item are displayed in order at approximately 0.5 second intervals. After the data are stored to memory, the screen returns to the original Measurement mode. Note the data set number on the *Field Data Sheet*.

5. Viewing stored data on the Horiba (note that the data cannot be transferred to a PC, only to a Horiba printer):
   5.1 Press the **DATA** key in the Measurement mode. The instrument goes into **DATA** mode.

   5.2 Press the **DATA** key. The measurement data are displayed. Data you want to call can be displayed by selecting a measurement item and data number.

   5.3 Press the **UP/DOWN** keys to switch the measurement item or number that has been selected with the **DATA** key.

   5.4 Press the **DATA** key. Use the **UP/DOWN** keys to switch between "Year, Month, Day' and "Hour, Minute, Second".

C. Specifications

Measurement range

Measurement item		Measurement range		Measurement units
		Expanded	Standard	
pH		0.00 to 14.00	0.0 to 14.0	pH
		—	−1999 to 1999	mV in pH measurement
Conductivity (COND)	Range 1	0.90 to 9.99	0.9 to 9.9	S/m
		9.0 to 99.9	9 to 99	mS/cm
	Range 2	0.090 to 0.999	0.09 to 0.99	S/m
		0.90 to 9.99	0.9 to 9.9	mS/cm
	Range 3	0.0 to 99.9	0 to 99	mS/m
		0.000 to 0.999	0.00 to 0.99	mS/cm
Turbidity (TURB) *1		0.0 to 800.0	0 to 800	NTU (nephelometric turbidity units) or mg/L
Dissolved-oxygen (DO)		0.00 to 19.99	0.0 to 19.9	mg/L
		0.0 to 199.9	0 to 199	%
Temperature (TEMP)		0.00 to 55.00	0.0 to 55.0	°C
Water depth (DEP)		0.0 to 100.0	0 to 100	m
		0.0 to 330.0	0 to 330	ft
Salinity (SAL)		0.00 to 4.00	0.0 to 4.0	%
Total dissolved solids	Range 1	5.5 to 65.0	5 to 65	g/L
(TDS) *2	Range 2	0.55 to 6.50	0.5 to 6.5	g/L
	Range 3	0.000 to 0.650	0.00 to 0.65	g/L
Seawater specific gravity (σ_t)		0.0 to 50.0	0 to 50	–
Oxygen-reduction potential (ORP)		—	−1999 to 1999	mV

*1: Depending on the concentration range, the minimum turbidity is displayed as follows:
0 to 100 NTU ... 1 NTU for standard readout, 0.1 NTU for expanded readout.
100 to 800 NTU ... 10 NTU for standard readout, 1 NTU for expanded readout.
*2: The TDS range depends on the TDS factor settings. (Above ranges are given for a TDS coefficient of 0.65.)

Oakton Waterproof pHTestr 2

For detailed instructions with graphics, along with important notes, please refer to the **Operation Manual**.

A. Calibration
   1. Before you begin: Remove electrode cap. To condition electrode, immerse electrode in electrode storage solution, buffer, or tap water for at least 30 minutes. **DO NOT USE DE-IONIZED WATER.**

   2. Calibration: Calibration should be done regularly, typically every day that the *Testr* is used. Calibrate the *pHTestr 2* at three points (pH 4, 7, 10).

      2.1 Press **ON/OFF** button to switch unit on.

      2.2 Dip electrode 1/2" to 1" into chosen buffer (pH 4, 7, or 10).

      2.3 Press **CAL** button to enter Calibrate (CA) mode. 'CA' flashes on the display. Then, a pH value close to the pH buffer value will flash repeatedly.

      2.4 After at least 30 seconds (about 30 flashes) press the **HOLD/CON** button to confirm calibration. The display will show '**CO**' and then switch to the buffer value reading.

      2.5 Repeat with other buffers if necessary (*pHTestr 2* only). Rinse electrode in tap water before dipping into next buffer.

B. Measurement
   1. Remove cap from the electrode and press the **ON/OFF** button to switch *Testr* on.

   2. Dip the electrode 1/2" to 1" into the test solution. Stir once and let the reading stabilize.

   3. Note the pH or press **HOLD/CON** button to freeze the reading. Press **HOLD/CON** again to release the reading.

   4. Press **ON/OFF** to turn off *Testr*. If you do not press a button for 8.5 minutes, the *Testr* will automatically shut off to conserve batteries.

   5. If possible, keep a small piece of paper or sponge in the electrode cap – moistened with clean water or electrode storage solution (**NOT DE-IONIZED WATER**) – and close the cap over the electrode.

C. Specifications

Specifications

	WP pHTestr 1	WP pHTestr 2
Range	–1.0 to 15.0 pH	
Resolution	0.1 pH	
Accuracy	±0.2 pH	±0.1 pH
Calibration	1 point (pH 4.0; 7.0; or 10.0)	3 points (pH 4.0; 7.0 and 10.0)
ATC	No	Yes
Operating Temperature	0 to 50°C (32 to 122°F)	
Functions	ON/OFF; HOLD; CA (Calibrate); CO (Confirm display); auto buffer recognition; auto-shutoff after 8.5 min. of nonuse	
Power	Three 1.5 V batteries (included). 24 hours continuous use (approx. 720 tests per battery set)	
Dimensions	6.5"L x 1.5" dia. (165 x 38 mm dia.)	
Weight	3.25 oz (90 gms)	

Oakton TDSTestr 20

For detailed instructions with graphics, along with important notes, please refer to the **Operation Manual**.

A. Calibration

1. Before you Begin: Remove electrode cap. Switch unit on for 15 minutes to stabilize the batteries. Soak electrodes for a few minutes in alcohol to remove oils. **Caution: Never immerse the electrode above color band as it will damage the instrument electronics.**

2. Calibration: Your tester features push- button calibration at two points (one per range). Select a calibration standard appropriate for each range: low range, between 150 to 1999 µS; high range, between 2.0 to 19.99 mS. It is best to select a standard close to the test solution value, and one that has a similar chemical make-up to the test solution.

   2.1 Rinse the electrode in tap or deionized water, then in a known calibration standard.

   2.2 Switch unit on (ON/OFF button).

   2.3 Dip electrode into calibration standard. **DO NOT immerse above color band!**

   2.4 Press CAL/CON button to enter Calibrate mode. 'CA' flashes on the display. An uncalibrated conductivity value close to the calibration standard value will flash.

   2.5 Wait at least 30 seconds (about 30 flashes) for the reading to stabilize. Press the HOLD/INC button repeatedly to adjust reading to match value of the known calibration standard.

   2.6 Press CAL/CON button to confirm calibration. The display will show 'CO' and then switch to a calibrated conductivity reading.

   2.7 For second range, repeat steps 1-6.

B. Measurement

1. Remove cap from electrode. Switch unit on (ON/OFF button).

2. Rinse the electrode in tap or deionized water, then in a small portion of test solution.

3. Dip the electrode into the test solution. Stir once and let the reading stabilize. **DO NOT immerse electrode above color band!**

4. Allow time for the Automatic Temperature Compensation to correct the readings for solution temperature changes.

5. Note the reading once the display is stable. Press HOLD/CON button to freeze the reading. Press HOLD/CON again to release the reading.

6. Press ON/OFF to turn off Testr. If you do not press a button for 8.5 minutes, the Testr will automatically shut off to conserve batteries.

C. Specifications

Specifications

TDSTestr	10	20
Range	0 to 999 ppm/ 1.00 to 9.99 ppt	0 to 1999 µS/ 2.0 to 19.99 mS
Resolution	1 ppm/ 0.01 ppt	1 µS/ 0.01 mS
Accuracy	±2% full scale	
Calibration	two-point push button slope adjustments (one in each range)	
Calibration Standard	100 to 999 ppm 2.00 to 9.99 ppt	150 to 1999 µS/ 2.0 to 19.99 mS
Operating Temperature	32 to 122°F / 0 to 50°C	
ATC	32 to 122°F / 0 to 50°C (1.11% per °F / 2% per °C)	
Power	Four 1.5 V alkaline batteries (Eveready A76BP; supplied) 20 hrs. continuous use Alternate replacement Model Eveready 303 silver oxide, 70 hrs. continuous use.	
Dimensions	5.9" x 1.7" x 1" (151 x 42 x 24 mm)	
Weight	3.25 oz (90 gms)	

Hanna Instruments HI 98129 Waterproof pH, EC/TDS & Temperature Multimeter

For detailed instructions with graphics, along with important notes, please refer to the **Operation Manual**.

A. Calibration
   1. pH calibration:
      1.1 From measurement mode, press and hold the MODE button until CAL is displayed on the lower LCD. Release the button. The LCD will display pH 7.01 USE or pH 6.86 USE (if you have selected the NIST buffer set). The CAL tag blinks on the LCD.

      1.2 For a single-point pH calibration, place the electrode in any buffer from the selected buffer set (e.g. pH 7.01 or pH 4.01 or pH 10.01). The meter will recognize the buffer value automatically.
         1.2.1 If using pH 4.01 or pH 10.01, the meter will display OK for 1 second and then return to measurement mode.

         1.2.2 If using pH 7.01, after recognition of the buffer the meter will ask for pH 4.01 as second calibration point. Press the MODE button to return to measurement mode or, if desired, proceed with the 2-point calibration as explained below.

      1.3 A two-point pH calibration give better accuracy. For a two-point pH calibration, place the electrode in pH 7.01 (or 6.86 if you have selected the NIST buffer set). The meter will recognize the buffer value and then display pH 4.01 USE.
         1.3.1 Rinse the electrode thoroughly to eliminate cross-contamination.

         1.3.2 Place the electrode in the second buffer value (pH 4.01 or 10.01, or, if using NIST, pH 4.01 or 9.18). When the second buffer is recognized, the LCD will display OK for 1 second and the meter will return to normal measurement mode.

      1.4 The CAL symbol on the LCD means that the meter is calibrated.

   2. EC/TDS calibration:
      2.1 From measurement mode, press and hold the MODE button until CAL is displayed on the lower LCD.

      2.2 Release the button and immerse the probe in the proper calibration solution: HI7031 (1413 µS/cm) for HI98129 and HI7030 (12.88 mS/cm) for HI98130.

      2.3 Once the calibration has been automatically performed, the LCD will display OK for 1 second and the meter will return to normal measurement mode.

      2.4 Since there is a known relationship between EC and TDS readings, it is not necessary to calibrate the meter in TDS

      2.5 The CAL symbol on the LCD means that the meter is calibrated.

B. Measurement

1. pH measurement:

1.1 Select the pH mode with the SET/HOLD button.

1.2 Submerge the electrode in the solution to be tested.

1.3 The measurements should be taken when the stability symbol on the top left of the LCD disappears.

1.4 The pH value automatically compensated for temperature is shown on the primary LCD while the secondary LCD shows the temperature of the sample.

2. EC/TDS measurement:

2.1 Select either EC or TDS mode with the SET/HOLD button.

2.2 Submerge the probe in the solution to be tested. Use plastic beakers to minimize any electromagnetic interferences.

2.3 The measurements should be taken when the stability symbol on the top left of the LCD disappears.

2.4 The EC (or TDS) value automatically compensated for temperature is shown on the primary LCD while the secondary LCD shows the temperature of the sample.

C. Specifications

Range Temperature:	0.0 to 60.0°C or 32.0 to 140.0°F	
HI 98129	pH: 0.00 to 14.00	
	EC: 0 to 3999 µS/cm	
	TDS: 0 to 2000 ppm	
HI 98130	pH: 0.00 to 14.00	
	EC: 0.00 to 20.00 mS/cm	
	TDS: 0.00 to 10.00 ppt	
Resolution	0.1°C or 0.1°F	
HI 98129	0.01 pH; 1 µS/cm ; 1 ppm	
HI 98130	0.01 pH, 0.01 mS/cm ; 0.01 ppt	
Accuracy (@20°C/68°F)	Temperature	±0.5°C or ±1°F
	EC/TDS	±2% f.s.
	pH	±0.01
Typical EMC Deviation	Temperature	±0.5°C or ±1°F
	pH	±0.02 pH
	EC/TDS	±2% f.s.
Temp.Compensation	pH: Automatic	
	EC/TDS: with β=0.0 to 2.4%/°C	
Environment	0 to 50°C (32 to 122°F); RH 100%	
EC/TDS Conversion Factor	0.45 to 1.00 (CONV)	
Calibration	pH: at 1 or 2 points with 2 sets of memorized buffers (pH 4.01/7.01/10.01 or pH 4.01/6.86/9.18)	
	EC/TDS: automatic, at 1 point	
EC/TDS Calibration Solutions		
HI 98129	HI7031 (1413 µS/cm)	
	HI7032 (1382 ppm; CONV=0.5)	
	HI70442 (1500 ppm; CONV=0.7)	
HI 98130	HI7030 (12.88 mS/cm)	
	HI70038 (6.44 ppt; CONV=0.5 or 9.02 ppt; CONV=0.7)	
Electrode	HI 73127 pH electrode (**included**)	
Battery Type/Life	4 x 1.5V with BEPS / typical 100 hours	
Auto-off	After 8 min.	
Dimensions	163 x 40 x 26 mm (6.4 x 1.6 x 1.0")	
Weight	85 g (3.0 oz)	